Attorney Docket No. P64765US1 Serial No. 09/779,461

c) determining from said intermediate statistical data a distribution of particles as a function of at least two arguments, wherein one argument is a specific brightness of the particles, or a measure thereof, and another argument is a diffusion coefficient of the particles, or a measure thereof,

wherein said distribution function of particles is determined by fitting the experimentally determined probability functions $\hat{P}_1(\mathbf{n}_1), \hat{P}_2(\mathbf{n}_2),...$ by corresponding theoretical probability functions $P_1(\mathbf{n}_1), P_2(\mathbf{n}_2),...$

and

wherein said theoretical probability distributions $P_1(\mathbf{n}_1)$, $P_2(\mathbf{n}_2)$,... are calculated as functions of apparent concentrations and apparent brightness which depend on the widths of the counting time intervals in the different sets.

- 39. The method according to claim 38 wherein, in calculations of the theoretical distributions $P_1(\mathbf{n}_1), P_2(\mathbf{n}_2), \ldots$, an optical spatial brightness function B@ is accounted for by a separately determined relationship between brightness B and volume elements dV.
- 40. The method according to claim 39, wherein the relationship between the spatial brightness B and volume elements dV is expressed through a variable $x = \ln(B_0/B)$ by a relationship

 $\frac{dV}{dx} = A_0 (1 + a_1 x + a_2 x^2) x^{a_3}, \text{ where } B_0 \text{ is maximum brightness and } A_0, \ a_1, \ a_2 \text{ and } a_3 \text{ are empirical parameters of the spatial brightness function.}$

- 41. The method according to claim 38 wherein each set of counting time intervals consists of intervals of equal width while different probability functions $\hat{P}_{T_1}(\mathbf{n}_1), \hat{P}_{T_2}(\mathbf{n}_2),...$ correspond to counting time intervals of different widths $T_1, T_2,...$
- 42. The method according to claim 42, wherein the apparent concentration is calculated as

Attorney Docket No. P64765US1 Serial No. 09/779,461

$$c_{app}(T) = \frac{c_{app}(0)}{\Gamma(T)},$$

the apparent brightness is calculated as

$$q_{app}\left(T\right) =q_{app}\left(0\right) \Gamma (T),$$

and $\Gamma(T)$ is calculated as

$$\Gamma(T) = \frac{1}{c_{ann}(0)q_{ann}^{2}(0)T^{2}} \int_{0}^{T} dt_{1} \int_{0}^{T} dt_{2}G(t_{2} - t_{1}),$$

where G(t) denotes autocorrelation function of fluorescence intensity and T denotes the width of the counting time interval.

- 43. The method according claim 38 wherein the counting time intervals in each set are consecutive in time.
- 44. The method according to claim 38 wherein, counting time intervals in each set overlap.
- 45. The method according to claim 38 wherein said intermediate statistical data are processed applying inverse transformation with regularization and/or constraints.
- 46. The method according to claim 38 wherein the theoretical distributions $P_1(\mathbf{n}_1), P_2(\mathbf{n}_2),...$ are calculated through their generating functions $G_{P(\mathbf{n})}(\bar{\xi}) = \sum_{n} \bar{\xi}^n P(\mathbf{n})$.
- 47. The method according to claim 38 wherein said distribution function of particles is determined by fitting the experimentally determined probability functions $\hat{P}_1(n_1), \hat{P}_2(n_2),...$ by corresponding theoretical probability functions $P_1(n_1), P_2(n_2),...$

Attorney Docket No. P64765US1 Serial No. 09/779,461

- 48. The method according to claim 47, wherein the theoretical probability functions $P_1(n_1), P_2(n_2), \dots$ are calculated through their generating functions $G_{P(n)}(\xi) = \sum_{i=1}^{n} \xi^n P(n)$.
- 49. The method according to claim 46, wherein the generating function is calculated using the expression $G(\xi) = \exp[\int dq c(q) \int d^3 \mathbf{r} (e^{(\xi-1)qB(\mathbf{r})} 1)]$, where c(q) is the density of particles with specific brightness q, T is the length of the counting time interval, and $B(\mathbf{r})$ is the spatial brightness profile as a function of coordinates.
- 50. The method according to claim 47, wherein said generating functions are calculated using the formula $G_{P(n)}(\xi) = \exp[\sum_i c_i \left[\left(e^{(\xi-1)q_iB(\mathbf{r})T} 1 \right) dV \right]]$ in which c is an apparent concentration and q is an apparent brightness which both depend on the width of the counting time interval T.
- 51. The method according to claim 38 wherein concentrations of particles are nelected to be approximately one or less molecules per measurement volume.
- 52. The method according to claim 38 wherein said photon detector is either an avalanche photodiode or a photomultiplier.
- 53. The method according to claim 38 wherein at least two photon detectors are used monitoring fluorescence of different wavelengths or polarization.
- 54. The method according to claim 38 wherein said fluorescent particles are characterized by applying an homogeneous fluorescence assay.
- 55. Use of a confocal apparatus for performing the method according to claim 38.
- 56. Use of a confocal apparatus for performing the method according to claim 38, said confocal apparatus comprising:
 - a) a radiation source (12) for providing excitation radiation (14),
 - b) an objective (22) for focusing the excitation radiation (14) into a measurement volume (26),

